

To be called the "Metro Area Network," CFU's coax/fiber hybrid system will offer comprehensive communication services to the residents, businesses, schools and city offices of Cedar Falls. Currently, CFU offers CedarNet, an Internet-based collection of home pages on the World Wide Web that is linked to various local services, institutions and organizations. The City of Cedar Falls also provides cable entertainment to hundreds of its 4,000 subscribers. Competition between CFU and TCI, the nation's largest cable TV company (and Cedar Falls' local provider), has significantly lowered the cost of monthly cable TV programming. When the entire system is installed in the fall of 1996, customers will have access to the Internet, electronic mail, video conferencing and additional high-speed data, voice and video services. The utility plans to add a host of other services including banking, shopping, home energy management, and a city-wide telephone service.

In addition to providing the community of Cedar Falls with cutting-edge communication services, CFU's network was designed to find new and better ways to manage utility distribution and monitor consumption. CFU's three utility divisions will benefit from advances in SCADA capabilities, distribution automation, demand side management, and automated meter reading. These mechanisms will increase the reliability, security and efficiency of CFU.

Gainesville Regional Utilities Gainesville, Florida

In 1993 the City of Gainesville Florida, the Gainesville Regional Utilities (GRU) have formed a communications utility GRUCom that is providing advanced telecommunications infrastructure to new competitive entrants, hospitals and other governmental entities, and the community at large.

Reasons for Developing Advanced Services

GRUCom started out as the result of a partnership between GRU and the Shands Hospital in Gainesville, Florida to install a fiber optic ring around the community for the purpose of supplying high bandwidth communications to various City and hospital facilities. The required services simply weren't offered by the local exchange company, BellSouth, or where they were available the cost was prohibitive. In 1995 the City opened the network to other local businesses and government entities also needing high bandwidth connectivity. This was done, in part, because it was recognized that a highly developed telecommunications network is important to the economic development of the area, but that the Gainesville market was viewed as third tier by most major telecommunications providers when considering where to invest and offer new services. If GRU did not get involved, Gainesville would lag behind other larger cities with regard to telecommunication services available at a reasonable cost.

Types of Services Offered

GRUCom currently offers high bandwidth transport for voice, data and video communications utilizing its fiber optic network, Internet access services and communication tower leases. In addition, GRUCom is currently installing a trunking radio system for use by public safety and governmental agencies in Alachua County. GRUCom has over 100 miles of fiber optic cable installed throughout Gainesville and Alachua County. The Synchronous Optical Network (SONET) technology and a ring topology are utilized to provide the maximum network protection, redundancy and reliability. The heart of the network is a five node OC-48 backbone loop. OC-48 transports information at 2.5 gigabits per second. Several subtending rings operating at various data rates feed into the backbone. GRUCom offers carrier access and private line circuits to customers at data rates ranging DS-1 (1.5 megabits) to OC-3 (155 megabits) and can tailor circuits to the requirements of the customer.

The GRUCom Internet access product offering is called GRUNet and also utilizes the fiber optic network for the delivery of service to the customer's premises. A network connection to the Internet is offered to other Internet Service Providers, businesses and other organizations needing dedicated Internet access at the T-1 level or higher. For customers subscribing to GRUCom services, GRUNet dial-up internet access is also available for employees and students at speeds of 14.4 kbps, 28.8 kbps, 33.6 kbps, 56 kbps and 128 kbps. The high-speed dedicated connectivity to the Internet allows local companies to conduct business over the Internet and the dial up service allows them to create an environment where their employees can access the local area network remotely. GRUCom also provides dedicated Internet connectivity to several Internet Service Providers in the Gainesville area

for their use in offering dialup service to their customers. GRUCom has recently established a local Network Access Point at its hub in Gainesville where local internet providers and major customers can interconnect for efficient handoff of local Internet traffic.

In addition to the services offered over the fiber optic network, GRUCom is also in the business of leasing antenna space on communication and water towers. The Federal Communications Commission has issued new licenses for wireless communications and several wireless service providers are working with GRUCom to co-locate their antennas on City facilities. The City currently has ten communications towers and two water towers located in and around Gainesville that are suitable for the co-location of antennas. By working with the wireless providers, GRUCom is helping to expand the communication services available in the area and reduce the number of new towers that must be built to provide these services.

The newest line of business for GRUCom will be trunking radio. GRUCom is in the process of building an 800 Megahertz trunking radio system. The City's existing radio systems are in need of replacement due to frequency allocation changes mandated by the Federal Communications Commission as well as poor performance. Trunking is a method that allows radio frequencies to be used more efficiently. While use of the available frequencies is restricted to public safety and other governmental departments, the new system will vastly improve the radio communications available to these entities. By stepping forward to assume the task of designing, licensing, financing, constructing, operating and managing the new system, all public agencies in Alachua County will benefit from the economies of scale and reasonable rates for the new service.

GRUCom is committed to providing communications services in the Gainesville area which are on par with those available in the larger metropolitan areas, at a fair price. We are continually looking at the changing technology and communication needs of the community. GRUCom will provide new products and services as required to foster economic development and maintain the high quality of life that exists in Gainesville.

Glasgow Electric Plant Board Glasgow, Kentucky

Summary

The project was meant to improve the way the City's electric utility sells electricity, provide a competitive cable television and telephone marketplace, and institute a city-wide computer "network of networks". These goals have been accomplished through the construction of 120 miles of bidirectional broadband plant which touches each home and business within the City. As a result, the people of Glasgow enjoy information age services today that the rest of the country is only beginning to anticipate at some yet-to-be-defined time in the future.

Demonstration of the Utility and Capability of the NII

The project effectively demonstrates the "highway" capabilities of the NII. The highway metaphor is appropriate since the system functions in much the same way as the city streets. Many different services are available to the people of Glasgow through the system at the same time. One lane of our "highway" carries telemetry and commands that the electric utility uses to operate its distribution and transmission system. Other lanes carry meter readings from electric and other utility meters and commands to control capacitor banks and outdoor lighting installations. Some of the highway is used to provide a competitive cable television service and a competitive telephone system. As a result, Glasgow is one of only a handful of cities which offers cable television service from more than one provider. Glasgow is probably the only city in the nation which offers dial tone from more than one source. Still other lanes are used to institute a city-wide metropolitan area network.

The city-wide network connects all of the K-12 classrooms, City agencies, utilities, and a growing number of homes and businesses. That means that children in an elementary school classroom can exchange E-Mail with the Mayor or the Superintendent of schools or a classmate with equal aplomb. It also means that parents can utilize the software, which they have purchased with their tax dollars or the schools, at night when before it was not being used at all. It also means that the lines of communication and involvement between parents, teachers, and school administrators (as well as the business community) have been opened up as they have never been before. Also, since all of the utilities and city and county agencies are on-line, most of the information which the public has bought and paid for is now available from any computer terminal in town which is attached to the network, twenty four hours a day. Amazingly, this information now comes to you instead of you having to go to city hall or the court house to get it.

A system like Glasgow's, flexible enough to accommodate whatever technology comes along or whatever services the people wish to receive, must be the distribution system which will be the electronic equivalent to today's local streets, driveways, and sidewalks. A National Information Infrastructure will be the equivalent of the Interstate Highway system which will provide the capability to leave the local systems like Glasgow's and move information all about the nation and the world.

Example of Practical Usage of the NII

This project's practicality is demonstrated in its very existence. It is not a pilot or demonstration but rather a real, on-going, growing and economically successful project. Its ability to better manage the distribution of electric power has saved the people of Glasgow over \$175,000 per year for over five years.

The competition in the cable television marketplace, which this project enables, saves the people of Glasgow over \$1.2 million per year through reduced rates. The value of the drastically improved service and the amount of local programming available to the local citizens also has great value albeit difficult to quantify. In reality, these two functions alone amortize the cost of constructing the system. However, there are benefits that are not directly based in economics. The cable service is also used to educate. Local broadcasts of government meetings and classroom activities go far beyond the norm for any cable operator. In fact, the system is used for interactive distance learning and one elementary school uses fifth graders to produce a weekly newsmagazine program which is broadcast live to everyone in town. Another channel is utilized by a high school marketing class. It is called the AdVantage Network and all of the programming and advertising sales are produced by the class and their programs are distributed right from the high school classroom. As a result, 50% of the potential cable television customers subscribe to our system. The telephone service offered by the project also puts GTE on its toes and has already convinced them to put in a new digital switch and offer services it does not offer in other markets as small as Glasgow.

Probably the most dramatic results of the project are only beginning to be realized in the provision of connections to the city-wide computer network. In the beginning it was only used to create a virtual education network to replace a system of many standalone networks with no connectivity to each other. The utility took what it had learned in tying the schools together and helped create a Geographic Information System tying PC workstations in city and county government agencies as well as local utilities to share mapping and databases with each other and the school network. Now the system includes a tie to all local traffic signals for synchronization and monitoring as well as the local realtors MLS information and soon the local law library.

The project is a powerful example of how anxious the public is to utilize the NII when it is made available. It shows how important it is to get started now. It also demonstrates how important it will be to not only make the capabilities available but also to create standard "cook-book" solutions and educate home and business owners on how to utilize the technology.

Encourages and Motivates Use of the NII

Over 350 other cities, 30 private companies, and scores of reporters and researchers have come to Glasgow to study our project. They come because it is real. It is delivering services which are cost effective to an ever increasing number of customers. It is founded in reality instead of conjecture. This project then encourages others to replicate it. In fact several cities are in the process of doing just that. When others see 34 people in a rural community of 14, 000 people are able to accomplish many of the services only mentioned as a dream by the prognosticators of the NII they rightly assume that they can do it too.

One of the big secrets to the success of our project has been our willingness to offer a total solution to our customers. The Glasgow network is convincing businesses that did not even own a PC to put in several PC's and a network and a file server. Why? Because the utility has been willing to design their networks, install them, recommend and install the software, provide connection to other networks, and support them on site as well as by telephone anytime they have a problem. This is not a new idea. It is called "customer service" and it is the only real obstacle that stands between the average consumer today and the consumer which is taking full advantage of the NII.

It is easy to see how the growth of the computer networking portion of our project will grow. Initially the utility supports the installation of a stand-alone network in one of its customers businesses. They teach them how to use the network and especially how to use E-Mail within that business location. Next they connect them to the city-wide network and educate them in the use of E-mail between themselves and other businesses and individuals within Glasgow. The utility also teaches them how to use the same network to access information on the school's file servers and the GIS file server. As the NII evolves and the network is tied to the Internet, customers will use the same skills they have been taught about accessing information and using E-Mail locally to fully exploit those capabilities to perform those communications with anyone in the world.

Thus, the innovation in the Glasgow project rests not solely in the technology of providing high speed communications directly to the home, it also is innovative in its "democratization" of this technology. This project aims to make the information, presently utilized by a precious few in major metropolitan areas at a very high cost, available to all at a cost roughly equal to the cost of providing the service. In other words, it takes the "highway" metaphor seriously.

Advice

Projects such as Glasgow's are much more deeply founded in politics than technology. A community must have a group of dedicated opinion leaders willing to communicate the vision of how everyone's lives can be enhanced through the creation of competition in former monopoly markets and the provision of information-age services today rather than tomorrow. This core group must be capable of communicating the relative simplicity of utilizing this technology if it is provided by local people willing to furnish complete

solutions and ongoing support for those willing to take a chance on the information superhighway.

Barriers

Even though projects like this one are most likely to be replicated in communities unlikely to be slated for installation of broadband networks by the telephone companies or cable companies anytime this century, those companies will likely protest if a community elects to construct a project similar to Glasgow's. However, this is actually a healthy situation. It is very likely that just such competitive pressures will be necessary to spark interest by the private sector in beginning to actually construct such systems instead of continuing to posture about how these systems will be constructed sometime in the future.

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Georgia Statewide Municipal Fiber Optic Network

MEAG Power

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Abstract

In early 1993, a group of municipals and the Municipal Electric Authority of Georgia (MEAG Power) discussed the notion of developing local community fiber optic networks interconnected by a statewide fiber backbone. The principal objective was to provide telecommunications services for the internal and core business needs of MEAG and the municipals. Once it was decided that a network would fulfill these needs, MEAG followed its statutory mandate to take advantage of economies of scale, and established two secondary objectives: (i) supplying broadband services for educational use and (ii) foster economic development by providing competitive telecommunications services through a state-of-the-art fiber optic infrastructure. With these objectives, the municipals and MEAG would offset their existing telecommunications expenses and create an additional revenue stream for their communities.

During this same period of time, the initial deployment of fiber optic cable and systems in a few of the cities was already underway. The fiber was typically being deployed for the municipals' core business but was also being installed at the request of specific customers. It became clear that the municipals could provide a beneficial service to their communities through the deployment of local fiber networks. Therefore, these municipals were anticipating the legal and regulatory changes that would be forthcoming and were anxious to provide services beyond their core business need.

Over the course of the last four years, there has evolved various Georgia municipal networks that will utilize MEAG Power's growing statewide fiber backbone. The statewide backbone will enhance their ability to meet the objectives described above.

Background

MEAG Power is a public corporation formed by the Georgia General Assembly in 1975 to provide wholesale electric power and related services to 48 municipals throughout the state of Georgia. MEAG's 1996 vital statistics include:

- **Customer's**
 - 48 Municipal Participants
 - 1 Wholesale Municipal Customer
 - 1,640 MW Peak Demand
 - 10.9 Billion kWh Sold
 - 3.7% Compound Annual Growth in Energy Sales since '85

- **Generation**

- 808 MW Nuclear - Plants Vogtle & Hatch
 - 750 MW Coal - Plants Wansley & Scherer

- **Transmission**

- 1247 Route Miles - 500kV - 46kV
 - Joint owner of Georgia's Integrated Transmission System (16,000+ Mi.)

In the early 1990's, MEAG and a core group of its municipalities standardized on a Supervisory Control And Data Acquisition (SCADA) platform that resulted in a statewide, wide area network (WAN). This SCADA WAN transmits telemetry, status and control data for MEAG's and the municipal's power operations. Shortly thereafter, MEAG worked with four of municipalities to establish Regional Monitoring Centers (RMC's) which enabled these municipalities to remotely monitor all MEAG's wholesale delivery points 24-hours/day by 7-days/week.

In addition, the WAN also enabled the provision of a client-server real-time weather application which provides real-time composite radar, single site radar and satellite imagery to the RMC's responsible for monitoring the MEAG delivery points. This system has rapidly expanded over the course of the last six years enabling additional MEAG municipalities or "MEAG SCADA participants" access to a centralized SCADA system for use in their respective municipality.

The municipal statewide SCADA system and the notion of future networked applications such as load management, remote revenue meter reading, interactive video distance learning, centralized equipment inventories, centralized billing systems and others amongst the municipalities and MEAG have been catalysts for developing a statewide fiber backbone. This paper will briefly describe the developments of four MEAG municipalities, Marietta, Thomasville, Lagrange and Newnan, all of whom are MEAG SCADA participants, whom in that order, have been the first municipalities in Georgia to become certificated as competitive local exchange carriers (CLEC) by the Georgia Public Service Commission (GPSC).

City of Marietta (Marietta FiberNet - www.MFN.net)

The city of Marietta, a northern Atlanta suburb (Figure 1), has an estimated population of 48,000, and through the Marietta Board of Lights and Water (MBLW) provides electricity to approximately 40,000 customers.

Marietta Power a division of MBLW, was responsible for the first deployment of fiber on Marietta's system. This fiber was installed at the request of a local hospital due to the need for broadband services between two of its locations. The city utilized existing distribution infrastructure to install fiber optic cable at the customer's request.

In the same time period of the installation for the hospital, it was apparent in, and around Atlanta, that competitive access providers (CAPs) were becoming established successfully.

As the regulatory climate changed, through the passage of *The Georgia Telecommunications and Competition Development Act of 1995* (the "Georgia Act," sometimes

called S.B. 137) and the federal *Telecommunications Act of 1996*, Marietta Board of Lights and Water formed the division of Marietta FiberNet (MFN). MFN actively developed a local telecommunications' strategy and was the first municipal in Georgia to make application for a Competitive Local Exchange Carrier (CLEC) certificate at the Georgia Public Service Commission (GPSC).

Marietta FiberNet has deployed and is actively expanding a SONET OC-48 network throughout Cobb Co., Georgia, and in addition has provided fiber connectivity to the MEAG Power headquarters in Fulton, Co. The objectives of MFN's network include providing broadband services to MBLW's and MEAG's core business, to local education, governments, and local businesses. The network will also foster competition amongst the competing local telecommunications service providers.

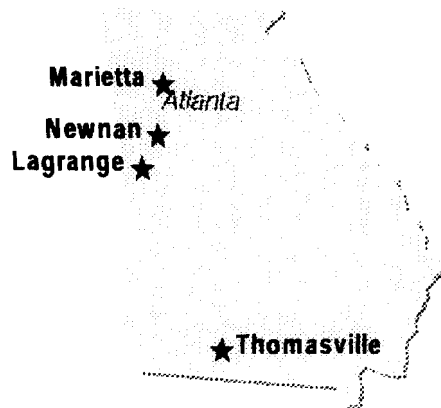


Figure 1

Georgia Public Service Commission (GPSC) - Marietta FiberNet Application

The Marietta FiberNet GPSC application was made in December, 1995 and was intervened by BellSouth, the Cable Television Association of Georgia (CTAG), AT&T and the Consumer's Utility Council (CUC). This application quickly became a focal point which would set statewide precedent on municipal entry into the telecommunications markets.

After two hearings, and considerable debate on the conditions to be imposed on MFN and potentially other municipals making CLEC applications, Marietta FiberNet was issued a CLEC certificate with the following conditions outlined below.

- **Universal Service Contributions on jurisdictional services**
- **Total Service Long-Run Incremental Cost (TSLRIC) study to demonstrate cost recovery in rates**
- **An appropriate accounting system demonstrating no cross-subsidies**
- **Pole attachments fees identical to those of other service providers**
- **Non-discriminatory franchise agreement with the City of Marietta**

- **Independent annual audit to ensure compliance with PSC conditions**

Stated in the findings and conclusions of the GPSC in Docket No. 6329-U:

*"The Georgia Act defines "telecommunications company" in O.C.G.A. 46-5-162(17), as "any person, firm, partnership, corporation, association **or municipal, county or local governmental entity** offering telecommunication services to the public for hire." The federal Act provides at Section 253 that "no State or local statute or regulation, or other State or local legal requirement, may prohibit or have the effect of prohibiting the ability of any entity to provide any interstate or intrastate telecommunications service."*

MFN is actively entering into agreements with Interexchange Carriers (IXC's) as a Competitive Access Provider (CAP) and in addition is providing broadband service to schools, local governments, and commercial businesses as it provisions services throughout Cobb County, Georgia.

Subsequent to the MFN docket at the GPSC, the following municipals have applied and received CLEC certificates with the same conditions.

City of Thomasville (www.Rose.Net)

Thomasville, Georgia, a rural community located in southwest Georgia (Figure 1), has an estimated population of 20,000 and approximately 13,000 electric customers. In 1995, the city of Thomasville, was the only municipal in the United States to receive a U.S. Department of Commerce, National Telecommunications and Information Administration (NTIA) grant for the deployment of video conferencing facilities between local schools. The city deployed an OC-48 SONET ring which provides broadcast quality interactive distance learning facilities to over twenty (20) Thomas County K-12 schools.

During that time, the city of Thomasville also configured their fiber network to provide data networking capabilities to their utility and city government operations. In addition, Thomasville provides network services to the local hospital as well as dial-up and broadband Internet service to it's community via *Rose.Net*.

Becoming the second municipal in Georgia to receive a CLEC certificate, Thomasville was the first MEAG municipal to provide competitive access services from their community across the statewide network. Thomasville as well is entering into agreements with IXC's, schools, local governments, and others as it provisions services throughout Thomasville, Georgia.

City of Lagrange (www.Lagrange-Ga.org)

Located in west Georgia approximately 60 miles southwest of Atlanta (Figure 1), the city of Lagrange has an estimated population of 30,000 and approximately 12,000 electric customers.

Lagrange was one of the first MEAG municipals to deploy fiber optic cable in an effort to promote competition and foster economic development. The city's initial installation of fiber was in conjunction with a carrier's carrier, in an effort to provide alternate access to select large industrial and commercial customers. While the city of Lagrange installed fiber optic cable on

their distribution system, the carrier installed a point-of-presence (POP) in Lagrange enabling Lagrange's customers to access IXC's at a more competitive rate than the incumbent local exchange carrier.

Most recently, The city of Lagrange has purchased the local cable system from Charter Communications. This resulted in a relationship between the city and Charter which enables the incumbent cable operator to continue providing cable TV services locally, while enabling the city to provide services supporting their core business objectives in electric, gas, water and sewer. In addition the city of Lagrange, being the third municipal to receive a Georgia CLEC certificate, will also provide other broadband services to the residences, schools, local governments and businesses in their community.

City of Newnan (www.west.ga.net/nwsl.html)

The city of Newnan, located approximately 35 minutes southwest of Atlanta (Figure 1), has an estimated population of 12,500 and through Newnan Water, Sewerage and Light Commission (NWSL), provides electricity to approximately 6,000 customers.

NWSL Commission initially deployed fiber optic cable within their community to interconnect an extensive SCADA system utilized for all of their utilities. It became immediately apparent that the fiber optic network was going to have a beneficial impact beyond the utilities' operations.

Since 1994, NWSL has been operating a SONET network that not only provided services to their utility operations but also provided data network connectivity between the schools in Coweta County and the Georgia Board of Regents statewide data network (PeachNet).

Recently, the city of Newnan, was the first municipality in Georgia to deploy and turn-up interactive services on a 750Mhz Hybrid-Fiber Coax (HFC) CATV system. The first customer was connected to the network in December of 1996. Since then, NWSL has connected over 2000 CATV customers to their network and upon request, provides broadband Internet connectivity as a value-added service. Most recently, the NWSL has announced that they will provision competitive local exchange services on the network through an alliance with a facilities-based Georgia CLEC.

MEAG Power (www.meagpower.org)

In 1995, the nine-member MEAG Telecommunications Committee was formed to set policies and direction to MEAG whom was in the planning process for the project. The Committee immediately established the core objectives of the statewide project which are principally, (1) Provide telecommunications for MEAG's core business needs and secondarily, (2) Enhance educational proficiencies through the provision of advanced telecommunications services and (3) Foster economic development.

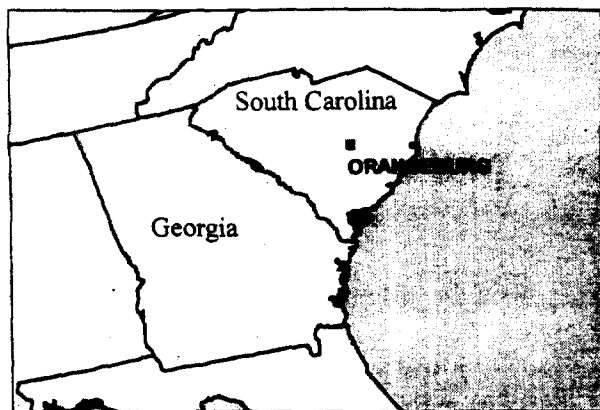
After a two year period of soliciting interest amongst MEAG's forty-eight (48) municipals, and after thirty-two (32) local city councils voted to approve their city's participation in the project, MEAG contracted with these thirty-two "Telecom Participants" in January, 1997

to construct a statewide fiber optic network. By this time, there had been two iterations of plans depicting the feasibility of the project and the Telecom Participants were extremely motivated to move forward with the project.

The statewide plan, developed in four (4) phases, outlined a sequence of projects based on need and economic viability. In May of 1997 the Telecom Committee recommended to the MEAG Board of Directors to proceed with the construction of the fiber network between Columbus, Ellaville, Americus, Albany, Camilla, Thomasville and Bainbridge, Georgia (Figure 2).

MEAG has completed the first 207 miles of fiber optic cable deployment and is currently operating an OC-48 SONET network between Thomasville, Camilla, Albany and Americus, Georgia. MEAG Telecom is actively engineering network segments to complete the route from south Georgia to Atlanta as well as the network segment from Marietta to Calhoun, Georgia. In addition, network segments in central Georgia will be constructed in conjunction with the deployment of local networks.

Orangeburg, South Carolina, Public Utilities



Orangeburg Public Utilities
195 Russell Street, SW
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Orangeburg, South Carolina is a community of 50,000 people located 50 miles east of Columbia. The city is home to several colleges, a regional health care facility and numerous industrial complexes. The Orangeburg Department of Public Utilities supplies electric, water, natural gas and sanitary sewer service to customers within the city limits. The electric division has approximately 25,000 customers. To improve internal communications, the city constructed its SCADA system in 1987. Its success led Orangeburg to develop plans expanding the size and scope of the system.

The City of Orangeburg hired a consulting group to assist them in the design and implementation of the fiber optic system. The current system includes 34 miles of fiber optics, linking together 14 substations, eight gas regulator stations, the water and wastewater plant, six water towers and five pump stations. Additional capacity has been reserved for future applications. The Department of Public Utilities uses T1/T3 technology, which gives them up to 672 voice-grade channels.

Orangeburg put up its first kilometer of fiber in 1989. The city felt that a fiber-based system offered a number of significant advantages because it is reliable, expandable and immune to lightning. The primary application of the fiber was to construct a SCADA system.

Once the system was in place, the City of Orangeburg began to utilize the full potential of fiber optics. One of Orangeburg's primary objectives was to cut communication costs by establishing

its own private phone system. With an internal dial tone, the Orangeburg public utilities department does not have to pay a monthly telephone service fee for every extension. The city is currently exploring other cost-saving initiatives, such as providing cable and television services through the fiber optic network and leasing space on the network to businesses and organizations.



THE PALO ALTO FIBER BACKBONE

A New Dimension in Telecommunications

SERVICE PROVIDERS

A key benefit of CPAU's fiber backbone is that you have access to your choice of service providers. No longer do you need to be limited to a single source for your telecommunications services. With a number of service providers competing for your business, you stand to benefit.

Telecommunications Carriers

Since the passage of the Telecommunications Act of 1996, the California Public Utilities Commission (CPUC) has certified 48 companies as facilities-based competitive local exchange carriers in California. Of these companies, 17 have filed tariffs with the CPUC and are currently authorized to provide competitive local telecommunications services. While not all of these companies will offer services in Palo Alto, CPAU's fiber backbone makes it possible for more of them to rapidly enter Palo Alto's telecommunications marketplace without the high cost of parallel construction of telecommunications infrastructure.

At least four local exchange carriers and three long distance carriers already have key network equipment in Palo Alto that is connected to the public switched telephone network, the Internet, and/or their private networks. Three other competitive local exchange carriers have indicated that they intend to site network equipment in Palo Alto in the coming months. CPAU's fiber backbone complements the equipment of all of these facilities-based telecommunications carriers by offering a means of rapidly connecting customers to their equipment via high capacity fiber optic links.

Internet Service Providers

With roughly 60 Internet service providers, Palo Alto may already have the highest number of Internet service providers per capita of any city in the world. Downtown Palo Alto is also home to the Digital Equipment Corporation's Palo Alto Internet Exchange (PAIX), a facility where Internet service providers exchange data between their networks. PAIX is a combined switching and commercial data center that is independent of any one Internet service provider or telecommunications carrier affiliation. A portion of CPAU's fiber backbone is located within PAIX, thus allowing you to gain direct access to the Internet service providers located there. Additional information about PAIX, including a list of participating Internet

service providers and telecommunications carriers, is available at <http://www.ix.digital.com/participating/participants.html>.

Contact Information

Discussions are underway with a number of telecommunications carriers and Internet service providers who have expressed interest in licensing fiber from CPAU to offer services in Palo Alto. Please contact us for the latest information about the service providers offering services over our fiber. Contact information is provided below for the Digital Equipment Corporation's Palo Alto Internet Exchange and for Brooks Fiber Communications, a telecommunications carrier that is currently providing services via fiber licensed from CPAU.

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Information about the Digital Equipment Corporation's Internet Exchange and Brooks Fiber Communications is provided as an informational service. It is not intended as a City of Palo Alto endorsement.



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THE PALO ALTO FIBER BACKBONE

A New Dimension in Telecommunications

KEY BENEFITS

With the Palo Alto fiber backbone, the City of Palo Alto Utilities (CPAU) is introducing a new concept in telecommunications. This extensive new fiber optic infrastructure promises to add a new dimension to Palo Alto's telecommunications marketplace in the form of an unprecedented level of competition and direct fiber access available to all.

Whether you license fiber directly from CPAU or procure telecommunications services from an independent service provider that licenses fiber from CPAU, the fiber backbone is capable of meeting all of your voice, data, and video needs. Individual fibers are available exclusively as dark fibers, meaning that the fibers are available without any light transmitters, receivers, or associated electronics attached to them by CPAU. You, or your service provider(s), are free to attach the voice, data, or video equipment of your choice to light the fibers and transmit information between locations that you designate.

With the fiber backbone, you could gain direct fiber access to your Internet service provider of choice. You could interconnect telephone systems or computer networks across multiple Palo Alto locations. You could connect directly to your local and/or long distance carrier(s) of choice for a full range of telecommunications services. Or you could provide redundant telecommunications connections for enhanced reliability. In short, the fiber backbone can meet your needs.

Some of the key benefits of connecting to the fiber backbone include:

Competition - With CPAU's fiber backbone, you have access to your choice of service providers. No longer are you limited to a single source for your telecommunications services. With a number of service providers competing for your business, you stand to benefit.

Reliability - The ring-based design of the fiber backbone allows for highly reliable network configurations, pushing service reliability to new levels.

Flexibility and Control - With CPAU's dark fiber, you are in control. You design your network, install your own choice of equipment, and provision the network to meet your needs.

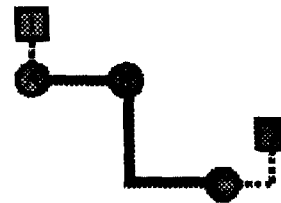
THE PALO ALTO FIBER BACKBONE

A New Dimension in Telecommunications

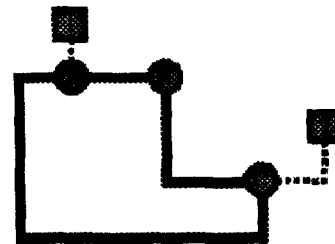
CONFIGURATION OPTIONS

The City will custom configure fiber optic pathways on the backbone as requested. A vast array of fiber backbone configuration options are available. Several examples are shown below:

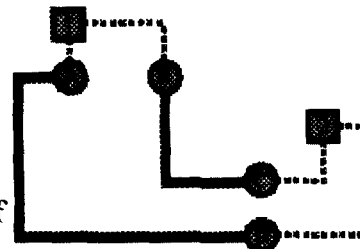
1. Point-to-Point - This configuration can be used to directly connect any two points in Palo Alto. The other four options are variations of this basic configuration.



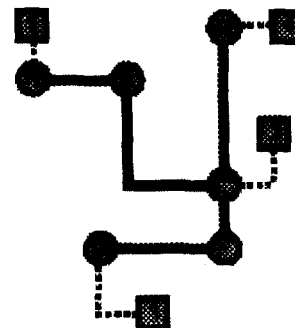
2. Route-Diverse Ring / Single Drops - With the proper network equipment, this configuration can be used to enhance reliability. Two diverse paths are available on the backbone to prevent service interruptions even if the fiber backbone is damaged along one of the two paths.



3. Route-Diverse Ring / Dual Drops - With the proper network equipment, this fiber configuration can be used to further enhance reliability. Two diverse paths are available end-to-end to prevent service interruptions even if the fiber backbone and/or the drop cable are damaged along one of the two paths.



4. Star Configuration - This configuration can be used to establish a single location as a hub from which individual point-to-point connections can be made.



City of Palo Alto Utilities
Fiber to the Home Trial
Answers to Frequently Asked Questions

Note: The information contained in this document represents the current view of the staff of the City of Palo Alto Utilities. Because the project has not yet been approved by the City Council and the network design has not yet been finalized, it should not be interpreted to be a commitment on the part of the City of Palo Alto.

1. Process Questions

1.1. Why is the City considering the fiber to the home trial? (7/16) - It is the goal of the City of Palo Alto to accelerate the rate at which affordable, advanced telecommunications services are available for all of the residents, businesses, and institutions of Palo Alto. Last year, the City constructed a fiber optic backbone that is now available for license. While initially limited, this was characterized as a positioning strategy that could be readily expanded if deemed appropriate at a later date. The fiber to the home trial is now being considered as a potential action to further accelerate the delivery of affordable advanced telecommunications throughout the community.

1.2. Has the fiber to the home trial been approved by the City Council? (7/16) - No, the trial has not yet been proposed to the City Council for approval; however, on July 13, 1998, a City Manager's Report was presented to Council informing them of the potential trial. Potential participants and trial areas must first be identified so that a budget and schedule can be developed. If a sufficient number of residents are interested in participating in the trial, we will plan on returning to Council for approval in late September.

1.3. How will trial areas be selected? (7/16) - Trial areas will be selected on the basis of the number of participants and the projected construction costs for each potential area. In order to be considered, a minimum of 50 homes passed and 30 percent participation will be required for any given trial area.

1.4. How can I improve my chances of having my neighborhood selected for the trial? (7/16) - We encourage you to coordinate with your neighbors, potentially through your local neighborhood association. Those neighborhoods with the highest participation densities will be most likely to be selected. By enabling the City to spread construction costs over a greater number of participants, this will also result in lower monthly fees for all participants.

1.5. How do I sign up to be a potential trial participant? (7/16) - Palo Alto residents will receive a notice of the opportunity to participate in the trial along with their next Utilities bill; a copy of this Utilities bill insert is also available online. Complete the form at the bottom and return it to us by August 31, 1998. You may submit the form online, e-mail the requested information to van_hiemke@city.palo-alto.ca.us, submit it with your utilities payment, or mail it separately to the following address:

Fiber to the Home Trial
City of Palo Alto Utilities, 8th Floor
P.O. Box 10250
Palo Alto, CA, 94303-0862

Palo Alto, CA, 94303-0862

1.6. Will I be obligated to participate if I submit a response? (7/16) - Although we urge you to only submit a response if you are seriously interested in participating, you will not be obligated to participate when you submit a response. If the project is approved by the City Council and your neighborhood is selected as a trial area, you will be required to sign an agreement and pay the initial connection fee before receiving service.

1.7. How can I coordinate with others who may be interested in participating? (7/16) - One potential venue is the PA-Comnet mailing list. PA-Comnet is a citizens' group that has urged the City to take steps that would facilitate the development of "a sustainable local infrastructure to support community dialogue, learning, and engagement that will lead to a revitalization of [the Palo Alto] community." PA-Comnet has a representative on the City's Telecommunications Advisory Panel, an advisory body for City staff. If you subscribe to the PA-Comnet list, you will be able to participate in email-based discussion with other PA-Comnet members via a Listserver provided by Smart Valley.

To subscribe, send e-mail to: majordomo@svi.org

In the message: subscribe pa-comnet

To UNsubscribe, send e-mail to: majordomo@svi.org

In the message: unsubscribe pa-comnet your-e-mail-address

To see who is on the list, send e-mail to: majordomo@svi.org

In the message: who pa-comnet

Majordomo will reply with a list of members.

Another potential venue is a local group such as a neighborhood association or condominium association. (See the answer to Question 1.8.)

1.8. Is my neighborhood planning a coordinated response? (8/28) - Given their regional nature, neighborhood associations or other ad hoc neighborhood groups are encouraged to coordinate on behalf of the residents in their neighborhoods. Contact information is provided below for people who have volunteered to be neighborhood coordinators:

Neighborhood	Boundaries	Contact Information
Barron Park	El Camino Real / Arastradero Rd. / Foothill Expwy. / Page Mill Rd.	Ken Poulton poulton@hpl.hp.com 650-857-1742 (home) 650-857-8461 (work)
College Terrace	El Camino Real / California Ave. / Amherst St. / Stanford Ave.	Barry Davidson davidson@grin.net 650-494-0894
Community Center	Middlefield Rd. / Channing Ave. / Embarcadero Rd.	Marvin Lee marvalis@aol.com 650-321-2285
Downtown North	Middlefield Rd. / Forest Ave. / Alma St. / Palo Alto Ave.	Andrew Smith andrew@extremenetworks.com

North	St. / Palo Alto Ave.	650-325-9132
Evergreen Park	Park Blvd. / El Camino Real / College Ave.	Roger Carpenter roger@alum.mit.edu 650-323-3118
Greenmeadow	Middlefield Rd. / San Antonio Rd. / Alma St. / Charleston Rd.	Ric Steinberger ric@sri.com 650-859-4300
Midtown	Alma St. / East Meadow Dr. / West Bayshore Rd. / Oregon Expwy.	Dave Cortesi cortesi@dsp.net 650-321-1986
North Fulton Area	Middlefield Rd. / Palo Alto Ave. / Chaucer St. / University Ave.	Michael Tompert michael@tompert.com 650-323-0365
Professorville	Middlefield Rd. / Forest Ave. / Alma St. / Embarcadero Rd.	Stuart Gannes sgannes@att.com 650-323-3342
Seale Addition #1	Middlefield Rd. / Embarcadero Rd. / Louis Rd. / Oregon Expwy.	Hank Magnuski hankm@netvideo.com 650-328-8230 (home) 408-747-0108 (work)
Seale Addition #2	Middlefield Rd. / Embarcadero Rd. / Alma St. / Oregon Expwy.	Peter Bright pbbright@prodigy.net 650-493-7192
South of Center	Middlefield Rd. / University Ave. / Center Dr. / Channing Ave.	Gary Bacon gbacon@educator.mci.net 650-321-7458 (home) 650-960-8871 (work)
South Palo Alto	Middlefield Rd. / East Meadow Dr. / San Antonio Rd. / West Bayshore Rd.	Arthur Keller keller@cs.stanford.edu 650-424-0202
Ventura Area	El Camino Real / Alma St. / Page Mill Rd. / W. Meadow Dr.	David C. Harris dharris@best.com 650-856-9126

If your neighborhood does not have a coordinator and you would like to volunteer, please send an email to us indicating your interest in being a neighborhood coordinator. In your email, please identify the name and boundaries of the neighborhood as well as the contact information you would like added to the above table.

1.9. Does the trial realistically exclude remote parts of Palo Alto from being considered for the trial? (7/27) - While the opportunity to express interest in the potential fiber to the home trial is available to every Palo Alto resident, we will factor the projected cost of the installation for each area into the evaluation of potential trial areas. As a result, it may turn out to be cost-prohibitive to include remote areas such as those homes west of Hwy. 280 at this time. All interested residents are nevertheless encouraged to submit a response. Even if an area is not selected for the

trial, it will be useful to develop a sense of the potential demand in other parts of Palo Alto as well. This will also help us plan for the future.

1.10. When do you expect to begin delivering service? (7/27) - If the fiber to the home trial is approved by the City Council in late September, we are targeting March 1999 for service delivery; however, this service date is subject to change based upon the nature of the trial areas involved.

1.11. What is the financial basis upon which the fees were developed? (7/27) - The estimated fees are based upon a cost recovery model using projected costs and participation rates. Actual fees will be based upon actual costs and participation rates.

1.12. What constitutes a "neighborhood"? (7/27) - For the purposes of the potential fiber to the home trial, a neighborhood may perhaps best be defined as "one or more potential cable paths from a common switch location". In a given trial area, fiber cables will be extended from a switch location down one or more streets past a number of potential participants. A minimum of 50 homes must be passed and a minimum of 30 percent of those homes must be willing to participate in the trial for a neighborhood to be considered as a potential trial area.

1.13. Can Palo Alto businesses participate in the trial? (7/27) - While we intend to limit the trial areas to residential areas, if a business is located in one of the trial areas, we may be able to include the business in the trial. Also, since we are striving to demonstrate telecommuting applications, we may also be able to include Palo Alto businesses in other areas that have employees located in the trial area(s); however, terms and fees for such an application have not yet been developed. Interested businesses are encouraged to submit a response along with a description of how they would like to use the service (e.g., telecommuting for Palo Alto resident employees, Internet access, interconnecting multiple facilities, etc.). Businesses interested in high speed Internet access or interconnecting multiple Palo Alto facilities may also want to consider the City of Palo Alto Utilities' dark fiber service.

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2. Price and Performance Questions

2.1. What services will be available? (7/27) - If approved by Council, the City will provide a local data transport service that will enable local connectivity across the City of Palo Alto Utilities (CPAU) network at speeds of 10 Mbps or 100 Mbps. Internet access and other services will be provided by service providers and content providers who connect to the CPAU network. As a part of the trial, we intend to facilitate applications such as high speed Internet access and telecommuting. It is also a goal of this trial to demonstrate other services such as video on demand, video multicasting, and video conferencing.

2.2. What is the difference between local connectivity and Internet connectivity? (7/27) - The network design is essentially a citywide, switched Ethernet-based, local area network. Local connectivity refers to connections between any locations in Palo Alto that are directly connected to the City of Palo Alto Utilities (CPAU) network. Internet connectivity refers to connections facilitated by third parties (e.g., Internet service providers) to locations that are not directly connected to the CPAU network. Such Internet connectivity must be obtained separately by trial participants. CPAU will identify Internet service providers that are interested in offering Internet access over the CPAU network.

2.3. How much will I pay for local connectivity? (7/27) - Participants will be required to finance the cost of the connection through an initial payment, plus ongoing monthly payments. An example of an estimated fee schedule for connection and monthly fees is shown below.

	10 Mbps Service	100 Mbps Service
Initial Connection Fee	\$1,200	\$2,400
Monthly Fee	\$10-35/month	\$20-70/month

Actual connection and monthly fees will depend upon the number of participants and actual costs incurred by the City. The above fees do not include charges for Internet access or other services that may be provided to you over the network. Internet access fees will be set by the service providers who choose to offer services over the network. (See the answer to Question 2.4.) You will also be responsible for completing any desired in-home networking.

2.4. How much will I pay for Internet access? How fast will my Internet access be? (8/28) - Internet service providers (ISPs) will establish their own service packages and price structures. For actual pricing, please contact the Internet service providers identified below for more information. In general terms, however, you will likely have a choice of dedicated or shared bandwidth for your Internet access. Dedicated bandwidth is better, but more expensive. While a

dedicated 10 Mbps connection would be very expensive (>\$10,000/month), a shared high speed connection should be reasonably priced. For example, suppose it costs an ISP \$2,500/month for a T-1 (1.5 Mbps) connection to a Tier 1 Internet access provider, and the bandwidth is shared across 100 trial participants. The cost per participant would be \$25/month. In this example, depending upon the number of participants using the network at any given time, the available bandwidth would range from 15 kbps to 1.5 Mbps. If an ISP shares a higher speed connection across both trial participants and other customers, the ISP could potentially allow for peak speeds of up to 10 Mbps (or more in the case of the 100 Mbps service) for trial participants. Given the large number of Internet service providers located in Palo Alto, we anticipate that a range of service levels and pricing plans will be available. (Please bear in mind that the speed of an end-to-end connection on the Internet is also influenced by congestion on the Internet and the speed of the link at the other end.)

2.5. What Internet service providers and content providers will provide services over the network? (8/28) - We are in the process of identifying Internet service providers (ISPs) and content providers that are interested in providing services over the network. We intend to allow any qualified ISP or content provider to provide service over the network. By allowing for competition among service providers, we hope to foster a marketplace characterized by innovative and competitively priced services. Additional information will be made available as interested service providers are identified. Service providers who are interested in providing service over the City of Palo Alto Utilities network should direct their inquiries to van_hiemke@city.palo-alto.ca.us.

Contact information is provided below for companies that have expressed interest in potentially providing service over the City of Palo Alto Utilities' proposed network:

POTENTIAL SERVICE PROVIDERS				
Company Name	Contact Person	Email Address	Phone Number	Web Site
DNAI	Carol "Patch" Garcia, Sales Coordinator	sales@dnai.com (Attn: Patch)	888-321-DNAI or 510-649-6110	www.dnai.com
FiberDirect	Christian Cojocneanu	available soon	408-730-5577	available soon
Palo Alto Fiberhood Networks	Michael Silverton	michael@fiberhood.net	650-494-3791	www.fiberhood.net
NanoSpace, Inc.	Frank Ray Robles	fiber@nanospace.net	650-833-8000	www.nanospace.net

This contact information is provided as an informational service only. It is not intended to be a City of Palo Alto endorsement or recommendation.

2.6. Is the range in the estimated monthly fee based upon the number of people that sign up in our area (i.e., the more who sign up, the less it will cost per household)? (7/27) - Yes. This is correct. In particular, the percentage of homes that participate in a given area is a strong driver of the ultimate cost per participant.